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Comparison of Boundary Datasets Covering Tibetan Plateau between 2021 and 2014 Versions

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Abstract: The updated version of the Datasets of the boundary and region of Tibetan Plateau 2021 was published in July 2021, which is the updated version of the Datasets of the boundary and area of the Tibetan Plateau that was published in June 2014. The main differences between the two versions are as follows: (1) Accuracy of the basic data used for 2021 boundary data has been improved, which is mainly based on the comprehensive analysis of high-resolution satellite remote sensing images and DEM (digital elevation modeling) data. (2) Geographical boundaries of the Tibetan Plateau have been extended from the 2014 version's restriction to China to a complete physical geographical unit at home and abroad, for which the main extensions include the southern slopes of the Himalaya, the Hindu Kush, and the Pamir Plateau. The administrative area now covers 9 countries, namely China, India, Pakistan, Tajikistan, Afghanistan, Nepal, Bhutan, Myanmar and Kyrgyzstan. The plateau area is now 308.34×10^4 km^2, an increase of 54.11×10^4 km^2 over the 2014 edition. (3) This dataset brings in attribute data for each section of the plateau boundary and data on characteristics of the highlands in areas adjacent to the plateau, the low basins within the plateau, and the lowlands of the marginal valleys obtained during the process of determining the plateau's range. The dataset of the 2021 version is archived in .shp and .kmz data formats and consists of 44 data files with data size of 1.07 MB.

Keywords: Tibetan Plateau; boundary; version 2021; vector data; area and boundary length; attribute characteristics

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The dataset supporting this paper was published and is accessible through the *Digital Journal of Global Change Data Repository* at: https://doi.org/10.3974/geodb.2021.07.10.V1 or https://cstr.escience.org.cn/CSTR:20146.11.2021.07.10.V1.

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1 Introduction

The formation and evolution of the Tibetan Plateau has a great impact on the natural environment and human survival and development in its surrounding areas[1–3], making it a research hot spot in geosciences and biology[1–7]. The boundary of the plateau is the initial basis for understanding the Tibetan Plateau. However, limited by a variety of factors, such as accumulated knowledge and technological development, scholars have differed greatly in their understanding and recognition of the Tibetan Plateau' boundary[7–9]. Li *et al*. discussed the extent of the Tibetan Plateau in 1987 and 2002[8,9]. Based on the 1:1 million landform sketch map and the 1:3 million landform map of the Tibetan Plateau and its surrounding areas, with topographic maps and satellite image interpretation analysis as the main basis, the 1:3 million scale boundary vector delineation and estimation of the plateau area within China was completed in 2002[9]. The corresponding GIS dataset was published in 2014[10,11]. With the second comprehensive scientific expedition of the Tibetan Plateau, the in-depth research on the resources, environment, and ecology of the plateau, combined with the accelerating construction of an ecological civilization on the plateau have jointly exerted new demands on the boundary determination of the Tibetan Plateau. The authors of the present dataset further clarify the principles and basis for determining the extent of the Tibetan Plateau, based on their understanding and knowledge of its physical and geographical units. Using recent research results and high-resolution remote sensing imagery and 30-m DEM data, the 2021 version of the vector data for the Tibetan Plateau' boundary was defined using ArcMap software. The specific research concerning the plateau range was published in Geographical Research[12].

2 Metadata of the Dataset

The metadata of the Boundary data of the Tibetan Plateau (2021 Version)[13] is summarized in Table 1. It includes the dataset full name, short name, authors, year of the

Table 1 Metadata summary of the Boundary data of the Tibetan Plateau (2021 Version) [13]

Items	Description
Dataset full name	Boundary data of the Tibetan Plateau (2021 Version)
Dataset short name	DBATP2.0
Authors	Zhang, Y. L., Institute of Geographic Sciences and Natural Resources Research (IGSNRR), Chinese Academy of Sciences (CAS), zhangyl@igsnrr.ac.cn Liu, L. S., IGSNR, CAS, liuls@igsnrr.ac.cn Li, B. Y., IGSNRR, CAS, liby@igsnrr.ac.cn Zheng, D., IGSNRR, CAS, zhengd@igsnrr.ac.cn
Geographical area	Asia, 25°59′30″N–40°1′0″N, 67°40′37″E–104°40′57″E
Data format	.kmz,.shp
Data size	1.07 MB
Data files	44 files, such as TPboundary.shp, and compressed into 5 files
Foundations	Second Tibetan Plateau Scientific Expedition and Research Program (STEP)(2019QZKK0603); the Strategic Priority Research Program of Chinese Academy of Sciences (XDA20040201)
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	***Data*** from the Global Change Research Data Publishing & Repository includes metadata, datasets (in the *Digital Journal of Global Change Data Repository*), and publications (in the *Journal of Global Change Data & Discovery*). ***Data*** sharing policy includes: (1) ***Data*** are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use ***Data*** subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute ***Data*** subject to written permission from the GCdataPR Editorial Office and the issuance of a ***Data*** redistribution license; and (4) If ***Data*** are used to compile new datasets, the 'ten per cent principal' should be followed such that ***Data*** records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset[14]
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS/ISC, GEOSS

dataset, data format, data size, data files, data publisher, and data sharing policy, etc.

3 Comparison of the 2021 and 2014 Versions of the Tibetan Plateau Boundary Dataset

The datasets underpinning the boundary and region of Tibetan Plateau version-2021 (hereon the "2021 version") and the boundary and area of the Tibetan Plateau released in 2014[9,10] were compared in several ways.

3.1 Geographical Boundary Comparison

Geographical coverage of the Tibetan Plateau extent dataset 2014 edition is limited to the territory of China. The 2021 version is based on the integrity of the physical geographical unit of the Tibetan Plateau, extending from that part within China to the whole Tibetan Plateau. The Tibetan Plateau (2021 version) starts from the northern edge of the Pamirs and the northern foothills of the West Kunlun Mountains–Altun Mountains–Qilian Mountains to the southern edges of the Hindu Kush Mountains, the Himalayas, and the Hengduan Mountains; it runs from the western edge of the Pamirs and Hindu Kush Mountains to the eastern edge of the Qilian Mountains and Hengduan Mountains. Overall, it lies within nine countries: China, India, Pakistan, Tajikistan, Afghanistan, Nepal, Bhutan, Myanmar, and Kyrgyzstan (Figure 1), having a range corresponding 25°59′30″N–40°1′0″N, 67°40′37″E–104°40′57″E, running north–south for about 1,560 km and east–west for about 3,360 km,

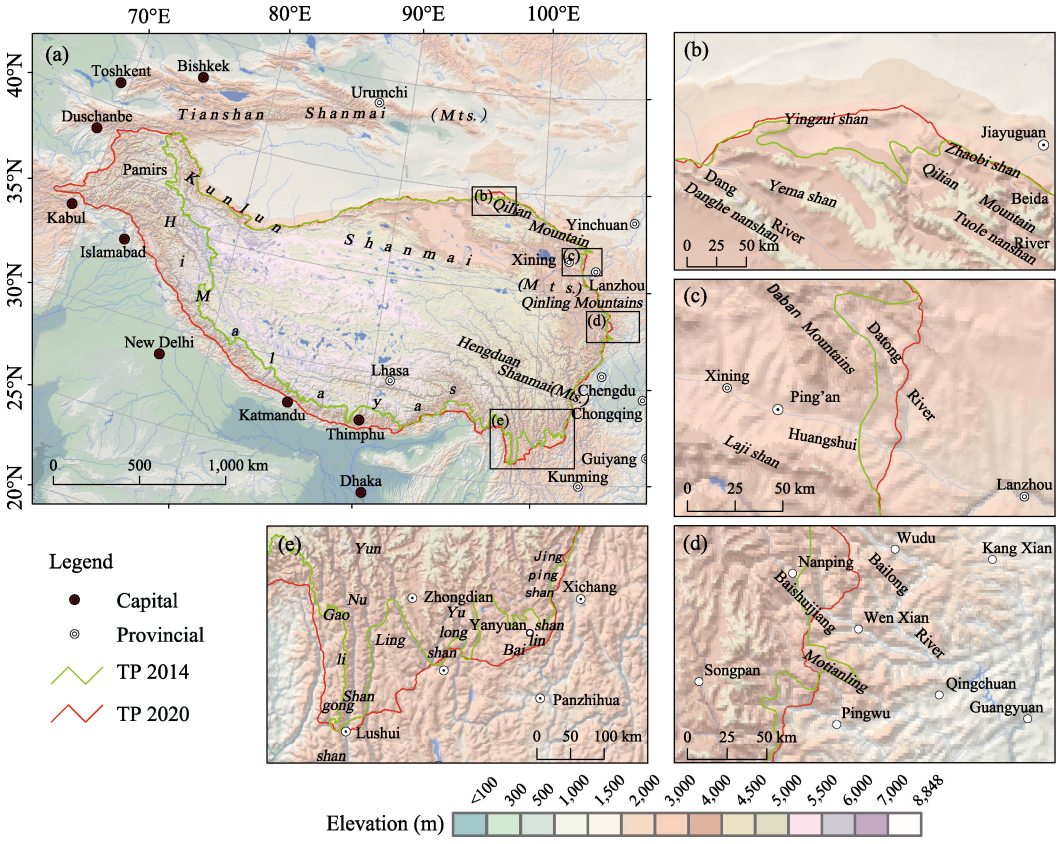

Figure 1 Comparison of the 2021 version[12,13] and 2014 version[9–11] of the Tibetan Plateau
(Note: Compiled on the basis of Figure 3 in ref. [12])

and encompassing a total area of 308.34×10^4 km^2 at an average altitude of about 4,320 m. Specifically, China harbors 258.13×10^4 km^2 of the plateau, with an average altitude of about 4,400 m, which spans six provinces and regions—Tibet autonomous region (TAR), Qinghai province, Gansu province, Sichuan province, Yunnan province and Xinjiang (mainly including TAR and Qinghai province)—involving 221 county administrative units (151 complete county administrative units are distributed in the plateau) (The area information of China and its administrative units is based on the 1:1 million national basic geographic database of the National Basic Geomatics Center, Ministry of Natural Resources[15].)

The area and boundary length of the 2021 and 2014 versions of the Tibetan Plateau vary substantially. When comparing the versions, the most westerly point changes the most, from 73°29′56″E in the 2014 version to 67°40′37″E in the 2021 version, an extension of 5°49′19″, while the southernmost point is increased by 8″ (Table 2). The total area is 54.11×10^4 km^2 greater in the 2021 than 2014 edition, an increase of 21.29%. The plateau's boundary length is now 10,094 km, which is 1,652 km less than in the 2014 version.

Table 2 Comparing the area and boundary length of the Tibetan Plateau in 2021 vs. 2014

	2014 version	2021 version	D-value	Change (%)
Geographic coordinates (4 vertices) *	East: 104°40′20″E West: 73°29′56″E South: 25°59′38″N North: 39°49′28″N	East: 104°40′57″E West: 67°40′37″E South: 25°59′30″N North: 40°1′0″N	East: +37″ West: +5°49′19″ South: +8″ North: +10′32″	
Area (km^2)	254.23×10^4	308.34×10^4	$+54.11\times10^4$	21.29 (+)
Boundary length (km)	11,746	10,094	–1,652	14.06 (–)

*When the 2014 version of the 4 vertices data was published in 2014, the 2002 version of MapInfo software format was transferred to ArcInfo software format, there was a slight fine adjustment.

3.2 Re-using Comparison of Basic Data

The types of information and their accuracy in the 2021 version data for the Tibetan Plateau have been greatly improved. The prior 2014 version was based on the 1:1 million scale topographic maps, while the 2021 version used recent research papers, other information sources, and map materials, along with Google Earth's high resolution remote sensing imagery and DEM data at a spatial resolution of 30 m. In the 2014 version, the west section of Motianling in the west of the Daba Mountains on the eastern boundary of the plateau, which lies at more than 4,000 m above sea level, was included in the Tibetan Plateau. In the 2021 version of the boundary delimitation, new data are used to analyze the boundary of that particular section. This revealed that the northwest–west orientation in the western section of Motianling and the northeast–east orientation in the mid-eastern section extend in an arc-like direction. That clearly differs from the north–south direction of the mountain on the east side of Minshan Mountains. And the Motianling and Minshan are separated from the valley by the upper reaches of the Fujiang river. Therefore, the 2021 version assigned the western part of Motianling to the Daba Mountains instead of the Qinghai-Tibetan Plateau (Figure 1d). By contrast, the northern mountains in the south of Bailong river and the northeast of Baishuijiang river (in the east of Nanping county) at an altitude of about 4,000 m are in a southeast orientation, not unlike the orientation for Minshan Mountain in the north; hence the former can be regarded as the southern extension of Minshan Mountain. In the 2021 version, they are classified together as Hengduan Mountains, which are part of the Tibetan Plateau (Figure 1d).

The 2021 version is more accurate than the 2014 version in determining the altitude of the Tibetan Plateau and the integrity of the mountains in the plateau[12]. From a geomorphogenesis perspective, the low basins and valley lowlands on the edge of the Tibetan Plateau were formed by local differential movement of the original plateau or river

erosion that occurred during the process of large-scale uplift of the Tibetan Plateau. Therefore, the low basins in the plateau, sloping ridge-like mountaintops, and valley lowlands should belong to the Tibetan Plateau. Yet some lowlands on the plateau's edge were excluded from the plateau in the 2014 version, generating a relatively large difference between the two editions of this part of the boundary data. As depicted in Figure 1b, 1c, and 1e in the 2014 version, the southern end of Hengduan Mountains has complex terrain, a relatively fuzzy plateau boundary, a tortuous boundary line, and a relatively long boundary length. The 2021 version is based on the continuous distribution of the plateau surface above 4,000 m, for which a unified top surface serves as the main basis for describing the scope of the Tibetan Plateau. Accordingly, from the perspective of the plateau's origin and consideration of its integrity, the residual planation surface, such as marginal lowlands (Yanyuan Basin), should also belong to the Tibetan Plateau, with a relatively straight boundary line and thus a relatively short length.

3.3 Boundary of Tibetan Plateau and Related Geomorphology

In the 2021 version of the Tibetan Plateau range dataset, the attribute data for each segment of the boundary were added. This supplementation includes data for the highlands in areas adjacent to the Tibetan Plateau, the low basins in the plateau, and the main valley lowlands at the boundary (Figure 2). These data are not found in the 2014 version.

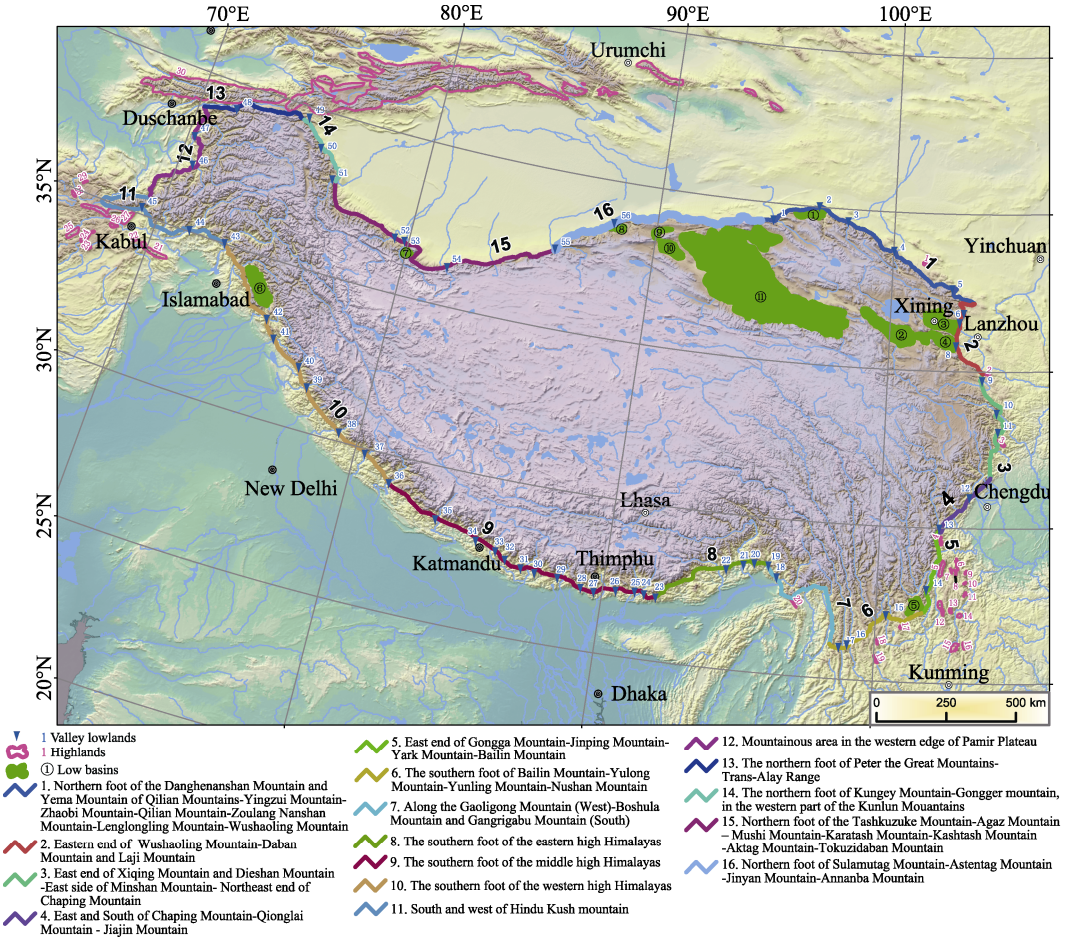

Figure 2 Range and boundary of the Tibetan Plateau

(Note: Serial numbers for each section of plateau boundary, highlands in adjacent areas, low-lying basin, and valley lowland in this figure correspond to those in Table 3–6, respectively.)

3.3.1 Plateau Range and Boundary Information of Each Section

The specific boundary and main features of each segment of the plateau are conveyed in detail in Figure 2 and Table 3. The 2021 dataset includes the refined boundary line (linear data) and geographical area (area data). Figure 2 is a reduced version of the boundary vector map of the Tibetan Plateau at a scale of approximately 1:1,000,000. Through the joint analysis of Figure 2 and Table 3, the scope of the Tibetan Plateau was thus obtained.

Table 3 Main characteristics of the boundary of each section of the Tibetan Plateau

ID	Subsection	Description
1	Northern foot of the Danghenanshan Mountain and Yema Mountain of Qilian Mountains–Yingzui Mountain–Zhaobi Mountain–Qilian Mountain–Zoulang Nanshan Mountain–Lenglongling Mountain–Wushaoling Mountain	Located in Gansu province, corresponding to the Qaidam Basin desert region and the Qilian Mountains of the eastern Qinghai high mountain and basin coniferous forest region, from the Dangjin Mountain Pass to the eastern end of Wushaoling Mountain. It is bordered by the plateau and mountains of sub-high altitude in the southern Hexi corridor. It is 1,004 km long with an average altitude of 2,770 m
2	Eastern end of Wushaoling Mountain–Daban Mountain and Laji Mountain	Located in Gansu and Qinghai province, corresponding to the Qilian Mountains of the eastern Qinghai high mountain and basin coniferous forest region. It is roughly on the front line of Tianzhu (northwest), Minhe, Jishishan (west), and Hezheng (south). It borders the medium and small undulating sub-high mountains in the west of the Loess Plateau, with a length of 398 km and an average altitude of more than 2,640 m. The boundary line intersects with the mountain strike vertically, and the geomorphic difference between the two sides is not obvious
3	East end of Xiqing Mountain and Dieshan Mountain–East side of Minshan Mountain–Northeast end of Chaping Mountain	Located in Gansu and Sichuan province, in the eastern part of the north section of Hengduan Mountains, corresponding to the Western Sichuan and Eastern Xizang high mountain and basin coniferous forest region, and Qilian Mountains of the eastern Qinghai high mountain and basin coniferous forest region. It is roughly on the line spanning Min county (southwest)–Dangchang county (southwest)–Wen county (west)–Pingwu (west)–Beichuan (west), bordering Qinling and Daba subalpine regions, with a length of 492 km and an average altitude of more than 2,170 m
4	East and South of Chaping Mountain–Qionglai Mountain–Jiajin Mountain	Located in Sichuan province, the eastern part of the middle Hengduan Mountains in Sichuan province, corresponding to the Western Sichuan and Eastern Xizang high mountain and basin coniferous forest region. It roughly lies near the Guanxian (west)–Baoxing (west)–Luding (east) line, linking up with the low and middle mountains on the western edge of the Sichuan Basin. It is 285 km long with an average altitude of more than 2,160 m
5	East end of Gongga Mountain–Jinping Mountain–Yark Mountain–Bailin Mountain	Located in the eastern mountainous area of the southern section of Hengduan Mountains in Sichuan province, corresponding to the Western Sichuan and Eastern Xizang high mountain and basin coniferous forest region and the Yunnan Plateau evergreen broadleaved forest and pine forest region. It lies roughly near the line of Luding–Shimian (west)–Mianning (west)–Yanyuan (south). It borders the southwest subalpine mountain areas of Sichuan province, with a length of 341 km and an average altitude of 2,300 m
6	Southern foot of Bailin Mountain–Yulong Mountain–Yunling Mountain–Nushan Mountain	Located in Yunnan and Sichuan, corresponding to the Yunnan Plateau evergreen broadleaved forest and pine forest region. It is roughly in the line of Yanyuan (south)–Ninglang (south)–Lijiang (north), Jianchuan (north)–Lushui. It is 430 km long and ca. 2,500 m above sea level. The boundary line intersects with the strike of the mountains nearly vertically, and the geomorphic difference between the two sides is not obvious
7	Along the Gaoligong Mountain (West) –Boshula Mountain and Gangrigabu Mountain (South)	Located in the southwest of Hengduan Mountains, except for a small part in Chayu, Tibet autonomous region, China, and most of the area distributed in the north of Myanmar and the northeast of India, corresponding to the southern East Himalayas Mountain seasonal rainforest and evergreen broadleaved forest region. It spans the east side of Enmeikaijiang River to Danlongqu River; it is about 526 km long with an average altitude of 2,150 m
8	Southern foot of the eastern high Himalayas	Located in Shannan and Linzhi of the Tibet autonomous region, China, corresponding to the southern East Himalayas mountain seasonal rainforest and evergreen broadleaved forest region, spanning roughly from Danlongqu River to Zhongli River near the border of Bhutan and China, and bordering subalpine mountains at the southern foot of the high Himalayas. It is 457 km long with an average altitude of more than 1,850 m

(*To be continued on the next page*)

(*Continued*)

ID	Subsection	Description
9	Southern foot of the middle high Himalayas	Located in Nepal, Bhutan, and Sikkim (India), corresponding to the evergreen broad-leaved forest region of the southern flank of the Middle Himalayas, it roughly spans the Zhongli River to the Karnali River (Peacock River) along the southern foot of the high Himalayas, bordering the low Himalayas, with a length of 1,123 km and an average altitude of 1,740 m
10	Southern foot of the western high Himalayas	Located in India, Kashmir, Pakistan, and Nepal, corresponding to the West Himalayan broad-leaved forest region. It roughly spans from the Karnali River (Kongque River) to the Indus River along the southern foot of the high Himalayas, bordering the low Himalayan Mountains, with a length of 1,113 km and an average altitude of 2,050 m
11	South and west of Hindu Kush Mountains	Located in Afghanistan and Pakistan, corresponding to mountainous dark coniferous forest, desert, and the xerophytic shrub area of eastern Afghanistan. It spans roughly from the Indus river to the west, along the north side of the Kabul river valley to the north of Bamian valley, from the northwest of Bamian around the Hindu Kush mountain, and then along the north side to the east in the vicinity of Banu. The boundary is bordered by the middle mountain and subalpine mountain on the edge of the valley. It is 724 km long with an average altitude of 2,360 m
12	Mountainous area in the western edge of Pamir Plateau	Located in Afghanistan and Tajikistan, corresponding to mountainous woodland and grassland of Central Asia and the alpine meadow of Hindu Kush. From Banu to the west end of the Peter the Great Mountains, it is bordered by sub-high mountains at the western foot of the Pamir Plateau. It is 528 km long with an average altitude of 2,450 m
13	Northern foot of Peter the Great Mountains–Trans–Alay Range	Located in Tajikistan, Kyrgyzstan, and Xinjiang of China, corresponding to Alai open woodland and the Pamir Alpine desert, lying roughly along the northern foot of the Peter the Great Mountains and the Trans-Alay Range to the eastern end of the Togoqiaoertao Mountain, and bordering subtropical mountains at the southern edge of the Kizilsu valley basin. It is 427 km long with an average altitude of 3,110 m
14	Northern foot of Kungey Mountain–Gongger mountain, in the western part of the Kunlun Mouantains	Located in Xinjiang, corresponding to the mountainous desert area of the northern flank of the Kunlun Mountains, spanning the eastern end of Tuoguoqiaoertao Mountain to the outlet of Yeerqiang River, and bordering the Loess-covered subalpine mountains in the southwest margin of the Tarim Basin. It is 284 km long with an average altitude of 2,680 m
15	Northern foot of the Tashkuzuke Mountain–Agaz Mountain-Mushi Mountain–Karatash Mountain–Kashtash Mountain-Aktag Mountain–Tokuzidaban Mountain	Located in Xinjiang, corresponding to mountainous desert zone, it spans the Yeerqiang River outlet to the Cheerchen River outlet, bordering the sub-high altitude plain platform and mountains in the southern margin of the Tarim Basin, having a length of 1,066 km and an average altitude of nearly 3,000 m
16	Northern foot of Sulamutag Mountain–Astentag Mountain–Jinyan Mountain–Annanba Mountain	Located in Xinjiang and Gansu, corresponding to the desert area of Qaidam Basin, it spans from the Che'erchen River's mouth to the Dangjin Mountain pass. It borders the sub-high and middle altitude plain platform and mountain areas in the Tarim Basin and the Hexi corridor's southern margin. It is ca. 854 km long with an average altitude of 2,620 m

3.3.2 Highlands in Adjacent Areas

Based on the DEM and remote sensing images, this study analyzed the spatial pattern of large landforms in the Tibetan Plateau and its adjacent areas, and defined the spatial distribution of the plateau and its adjacent areas at an altitude of about 4,000 m and above. Except for the Tibetan Plateau region and Tianshan Mountains, the other 30 highlands at over 4,000 m and their main features are included in the dataset (Table 4). They are scattered and discontinuous from the surface of the Tibetan Plateau, often separated by tectonic basins and valleys, and are fault-block mountains outside the Tibetan Plateau[12]. This also further verifies the feasibility of the principle of defining the range of the plateau based on its continuous distribution above 4,000 m and the reliability of the data obtained.

3.3.3 Low Basins in the Plateau

There are, however, some low-lying basins on the inner edge of the Tibetan Plateau, which are 1,000–2,000 m lower than the plateau. Eleven basins with an altitude of 1,600–2,900 m, such as the Qaidam Basin, Gonghe Basin, and Kashmir valley, were extracted and their characteristics briefly analyzed (Table 5). These low basins are the relative lowlands formed

Table 4 Highlands in the adjacent areas of the Tibetan Plateau*

ID	Name	Location	Description
1	Dahuang Mountain	Zhangye city and Jinchang city of Gansu province; 38.4°N, 101.3°E	Located at the junction of Shandan county and Yongchang county, at an altitude of 3,976 m a.s.l., it has a nearly east–west orientation and is about 18 km long
2	Baishi Mountain	Gannan prefecture and Dingxi city of Gansu province; 34.9°N, 104°E	Located at the junction of Zhuoni county, Weiyuan county, Zhangxian county, at an altitude of 3,900 m a.s.l., it has a nearly east–west orientation and is about 20 km long
3	Motianling Mountain	Longnan city of Gansu province and Mianyang city of Sichuan province; 32.7°N, 104.5°E	Located at the junction of Wen county, Pingwu county, and Qingchuan county, at an altitude of 4,000 m a.s.l., it has a nearly east–west orientation and is about 40 km long
4	Ma'anshan Mountain	Ganzi prefecture and Ya'an city of Sichuan province; 29.6°N, 102.3°E	It has a nearly north–south orientation and is about 30 km long. Ma'anshan Mountain, the highest peak, is 4,021 m a.s.l.
5	Xiaoxiangling Mountain	Liangshan prefecture and Ya'an city of Sichuan province; 28.7°N, 102.4°E	It has a north–northeast orientation and is almost 60 km long. Baonanshi, the highest peak, is 4,750 m a.s.l.
6	Tekehonghong Mountain	Liangshan prefecture and Leshan city of Sichuan province; 28.6°N, 102.9°E	Located at the junction of Ganluo county and Ebian county, it has a nearly north–south orientation and is about 40 km long. Ma'anshan Mountain, the highest peak, is 4,288 m a.s.l.
7	3957 Highlands	Liangshan prefecture of Sichuan province; 28.6°N, 102.7°E	It has a north–northwest orientation and is nearly 20 km long. The highest peak is 3,957 m a.s.l.
8	3881 Highlands	Liangshan prefecture of Sichuan province; 28.6°N, 102.9°E	It has a nearly north–south orientation and is about 20 km long. The highest peak is 3,881 m a.s.l.
9	Dafengding	Liangshan prefecture and Leshan city of Sichuan province; 28.6°N, 103.2°E	Located at the junction of Meigu county and Mabian county. Moluowengjue has a north–northeast orientation and a length of about 10 km. The highest peak is 4,035 m a.s.l.
10	Huangmaogeng	Liangshan prefecture of Sichuan province; 28.3°N, 103.2°E	Located at the junction of Meigu county and Leibo county, it has an almost northeast–southwest orientation and is about 10 km long. The main peak, Shuenomuchihe, is 3,962 m a.s.l.
11	Shizi Mountain	Liangshan prefecture of Sichuan province; N27.9°, E103.2°	Located at the junction of Jinyang county, Leibo county, and Zhaojue county, it has a north–northeast orientation and a length of about 18 km; the highest peak of Shizishan is 4,076 m a.s.l.
12	Luoji Mountain	Liangshan prefecture of Sichuan province; 27.5°N, 102.4°E	It has a north–northwest orientation and is more than 50 km long. The altitude of the highest peak is 4,359 m a.s.l.
13	Pugedong Mountain	Liangshan prefecture of Sichuan province; N27.4°, E102.7°	It has a nearly north–south orientation and is about 20 km long. The altitude of the highest peak is more than 3,800 m a.s.l.
14	Yao Mountain	Zhaotong city of Yunnan province; N27.2°, E103°	It has a nearly north–south orientation, with a length of more than 10 km. The highest peak, Jiaoding Mountain, is 4,041 m a.s.l.
15	Gongwang Mountain	Kunming of Yunnan province; 26.1°N, 102.9°E	It has a nearly north–northeast orientation and is about 40 km long. Xueling, the main peak, is 4,344 m a.s.l.
16	Guniu Mountain	Qujing city, Kunming city of Yunnan province; 26.1°N, 102.9°E	It has a nearly north–south orientation and is about 25 km long. Daguniu Mountain, the highest peak, is 4,017m a.s.l.
17	3953 Highlands	Lijiang city of Yunnan province; 26.8°N, 100.9°E	At an altitude of 3,953 m a.s.l., in a north–northeast orientation, it is about 10 km long.
18	Nanwu Mountain	Dali prefecture of Yunnan province; 26.3°N, 100.1°E	It has a nearly north–south orientation and is about 20 km long. The highest peak is Nanwu Mountain, at an altitude of 3,958 m a.s.l.
19	Diancang Mountain	Dali prefecture of Yunnan province; 25.6°N, 100.1°E	It has a north–northeast orientation and is about 30 km long. Malong Mountain, the highest peak, is 4,122 m a.s.l.
20	3981 Highlands	India, Myanmar; 27.4°N, 96.9°E	It has a north–northwest orientation and is about 38 km long. The highest peak is 3,981 m a.s.l.
21	Spin Ghar Range	Afghanistan, Pakistan; 34.05°N, 69.9°E	It has a nearly east–west orientation and is about 100 km long. Sikaram, the highest peak, is 4,755 m above sea level.
22	Kuh-e Soltan Saheb	Afghanistan; 34.15°N, 69.42°E	It is about 15 km in length. Kuh-e Soltan Saheb, the highest peak, is 4,270 m a.s.l.
23	4551 Highlands	Afghanistan; 33.4°N, 67.9°E	At an altitude of 4,551 m, in a northeast–southwest orientation, it is about 15 km long.
24	Kuh-e Sefid	Afghanistan; 33.66°N, 67.63°E	It has a northeast–southwest orientation and is about 60 km long. The highest peak, Kuh-e Sefid, is 4,750 m a.s.l.

(*To be continued on the next page*)

(*Continued*)

ID	Name	Location	Description
25	Shah Tus Aqa Ghar	Afghanistan; 33.62°N, 67.05°E,	It has a northeast–southwest orientation and is about 50 km long. Shah Tus Aqa Ghar, the highest peak, is 4,803 m a.s.l.
26	Spina Kada (Tōr Tsūk)	Afghanistan; 34.3°N, 68.5°E	It has a nearly east–west orientation, with a length of nearly 30 km. Spina Kada, the highest peak, is 4,377 m a.s.l.
27	Baba Mountain Range	Afghanistan; 34.6°N, 67.6°E	The highest peak, Foladi peak (Shah Fuladi), is 4,951 m a.s.l.; it is a mountain on the outer margin in the south of the Hindu Kush Mountains, with a length of 180 km and having a nearly east–west orientation
28	Kata Kuh	Afghanistan; 34.8°N, 66.5°E	At an altitude of 4,550 m a.s.l., in a northwest–southeast orientation, it is about 25 km long
29	Band-e Surkhak	Afghanistan; 33.3°N, 66.8°E	It has a northeast–southwest orientation and is about 20 km long. Band-e Surkhak, the highest peak, is 4,174 m a.s.l.
30	Alay Range	Northern outer edge of the Pamirs	It has a nearly east–west orientation and is more than 5,00 km long. Pik Tandykul, the highest peak, is 5,544 m a.s.l.

*Note: Latitude and longitude of the highland position are generally calculated using the position of the highest peak of the mountain range.

Table 5 Distribution of main low basins in the plateau (altitude < 3,000 m a.s.l.)

ID	Name	Location	Description
1	Upper reaches of Changma River and Tashi River basin	Jiuquan city, Gansu province; 39.6°N, 96.3°E	With an area of about 2,200 km^2, at an average altitude of about 2,400 m, it is the northwest piedmont basin of the Qilian Mountains. The altitude of the surrounding mountains is about 3,500–4,500 m
2	Gonghe basin	Hainan and Haixi prefectures of Qinghai province; 36.2°N, 100°E	With an area of about 7,200 km^2, at an average altitude of about 2,900 m, it is a basin between the Qinghainanshan Mountain of Qilian Mountains and the Ela Mountain of Kunlun Mountains. The altitude of the surrounding mountains is about 4,300 m
3	Huangshui valley basin	Mainly in Xining city and Haidong city of Qinghai province; 36.5°N, 102°E	With an area of about 5,700 km^2, at an average altitude of about 2,200 m, it is a basin between the Laji Mountain and the Daban Mountain. The altitude of the surrounding mountains is about 4,000 m
4	Yellow River valley basin (Guide, Jianzha, Xunhua basin)	Hainan, Guinan and Haidong prefectures of Qinghai province; 36°N, 102°E	With an area of about 3,200 km^2, at an average altitude of about 2,000 m, it is a basin between the Laji Mountains and Zamarigang-Yeerpgang. The altitude of the surrounding mountains is about 4,000 m
5	Yanyuan basin	Yanyuan county of Liangshan prefecture in Sichuan province; 27.5°N, 101.4°E	With an area of about 1,500 km^2, at an average altitude of about 2,400 m, it is a piedmont basin on the southeast edge of the Hengduan Mountains. The altitude of the surrounding mountains is about 35,00–4,100 m
6	Kashmir valley	Kashmir; 34°N, 74.6°E	With an area of about 5,200 km^2, at an average altitude of about 1,600 m, it is a basin between the Pir Panjal Range and the high Himalayas. The altitude of the surrounding mountains is about 4,300 m
7	Pixia River valley	Hotan prefecture of Xinjiang Uygur autonomous region; 36.3°N, 80°E	With an area of nearly 400 km^2, at an average altitude of about 2,700 m, it is a piedmont basin of West Kunlun. The altitude of the surrounding mountains is about 4,100 m
8	Upper Ruoqiang River basin	Ruoqiang county of Xinjiang Uygur autonomous region; 38.5°N, 88.3°E	With an area of about 700 km^2, at an average altitude of about 2,800 m, it is a piedmont basin of the Altun Mountains. The altitude of the surrounding mountains is about 3,800 m
9	Wuxiaoer basin	Ruoqiang county of Xinjiang Uygur autonomous region; 38.5°N, 90°E	With an area of about 900 km^2, at an average altitude of about 2,900 m, it is a piedmont basin of the Altun Mountains. The altitude of the surrounding mountains is about 4,300 m
10	Gasikule low basin	Mangya county of Qinghai province and Ruoqiang county of Xinjiang Uygur autonomous region; 38.1°N, 90.7°E	With an area of about 2,500 km^2, at an average altitude of about 2,900 m, it is a piedmont basin between the Altun Mountains and Kunlun Mountains. The altitude of the surrounding mountains is 3,500–4,500 m
11	Qaidam low basin	Haixi prefecture of Qinghai province and Jiuquan city of Gansu province; 37°N, 90°E	With an area of 90,000 km^2, at an average altitude of about 2,700 m, it is the basin between Kunlun Mountains, Altun Mountains, and Qilian Mountains. The altitude of the surrounding mountains is about 4,400 m

by local differential movement during the uplift evolution of the Tibetan Plateau, and differences in elevation among these basins reflects the uneven intensity of tectonic movements[10].

3.3.4 Main Valley Lowlands at the Plateau Boundary

At the lowest altitude are the valley lowlands at the Tibetan Plateau's edge, which lie 1,500–2,500 m (or even more) below the plateau itself. This dataset extracted the elevation of valley bottoms of 56 major rivers around the boundary of the plateau, among which the least value was for the Tista River at 220 m, and the greatest for the Keriya River at 2,680 m, with an overall average of 1,220 m (Table 6). With the uplift of the Tibetan Plateau, the rivers at the edge of the plateau incised downward from the plateau and gradually formed these deep-valley lowlands. The difference in elevation across the valley lowlands reflects the differential erosion and cutting intensity of rivers. Based on the principle of integrity, these valley lowlands and the beam-like plateau on both sides are now included in the scope of the Tibetan Plateau[12].

Table 6 Altitude of main valley lowlands at the plateau boundary

ID	Name	Altitude of valley floor at the boundary of Plateau (m)	ID	Name	Altitude of valley floor at the boundary of Plateau (m)	ID	Name	Altitude of valley floor at the boundary of Plateau (m)
1	Danghe River	2,330	20	Yarlung Zangbo River	300	39	Sutlej River	910
2	Changma River	1,930	21	Xiyueer River	340	40	Beas river	1,150
3	Beida River	2,070	22	Subansiri River	330	41	Ravi river	540
4	Heihe River	2,320	23	Zhongli River	1,040	42	Chenab River	840
5	Zamu River (Shiyang River)	2,600	24	Danma River	550	43	Indus River	600
6	Datong River	1,920	25	Kur River	500	44	Kunar River	910
7	Huangshui River	1,760	26	Sankosh River	440	45	Darya-ye Panisher	1,650
8	Yellow River	1,800	27	Quluo River	930	46	Tagab-e Monjan	1,220
9	Taohe River	2,400	28	Torsa River	480	47	Amu Darya River	860
10	Bailong River	1,270	29	Teesta River	220	48	Muksu River	2,040
11	Baishui River	1,120	30	Pumqu River	290	49	Malkansu River	2,370
12	Min River	870	31	Dhudh Koshi River	500	50	Gaiz River	2,010
13	Dadu River	1,280	32	Tama Koshi River	850	51	Yeerqiang River	1,710
14	Yalong River	1,290	33	Sun Koshi	810	52	Qaraqash River	1,930
15	Jinsha River	1,390	34	Girong Tsangpo	630	53	Yurungkash River	1,740
16	Lancang River	1,390	35	Kali Gandak River	860	54	Keriya River	2,680
17	Nujiang River	850	36	Karnali River	700	55	Qarqan River	2,400
18	Zayu River	490	37	Kali River	880	56	Ruqiang River	1,620
19	Dalung Qu	460	38	Alakananda River	920			

4 Discussion and Conclusion

Vis-à-vis the 2014 version, the 2021 version is perfected in terms of the time, accuracy, and description of the plateau data. It provides a scientific definition of the scope of the Tibetan Plateau on the basis of recent experts' cognition and technical level. The scope of the Tibetan Plateau has expanded from only inside China to now include the physical geographical units inside and outside China. The vector data of the Tibetan Plateau, which based on 30-m DEM and high-resolution remote sensing imagery, is more precise than the previous data based on the 1∶1 million scale topographic map. Their corresponding reduced data are the "Tibetan Plateau range and boundary map of each segment" and "Main characteristics table of each segment boundary of Tibetan Plateau", which show the specific range, boundary, longitude and latitude, area and other plateau characteristics of Tibetan Plateau, and clarify the natural characteristics of the boundary in 16 segments.

The data for "Highlands in the area adjacent to the plateau" basically covers the whole area around the plateau, which is not always contiguous with the surface of the Tibetan Plateau, and they are fault-block mountains outside the Plateau[12]. Nonetheless, it shows the scientific principle of defining the scope of the plateau based on the continuous distribution of its surface at an altitude of at least 4,000 m[12]. At the same time, highlands in the area

adjacent to the plateau are also of great significance to study the spatial patterning and structure of the plateau and its adjacent areas.

This dataset also provides a systematic description of the lowlands that obviously lie below the Tibetan Plateau surface. This study analyzes the spatial distribution and main characteristics of the 11 main low basins in the plateau and the 56 main river valley lowlands at its boundary. It is of great importance to enhance the accuracy of the plateau's boundary determination by using the "integrity of plateau mountains" principle[12]. The difference in altitude between the low basin and main river valley at the boundary of the plateau reflects differences in their tectonic movement or river erosion intensity, which is also a valuable and timely reference for further research on the geomorphic evolution of the Tibetan Plateau.

Author Contributions

Zhang, Y. L. and Zheng, D. created the overall design for the development of the dataset; Li, B. Y., Liu, L. S. and Zhang, Y. L. processed the vector data of the plateau boundary, highlands in adjacent areas, and low basin and valley lowlands; Zhang, Y. L., Liu, L. S. and Li, B. Y. wrote the data paper.

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Conflicts of Interest

The authors declare no conflicts of interest.

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